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ON A NEW SPECIES OF *HALOBATES*, A GENUS OF PELAGIC HEMIPTERA

BY

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Zoological Laboratory, Cambridge.

WITH SEVEN TEXT-FIGURES

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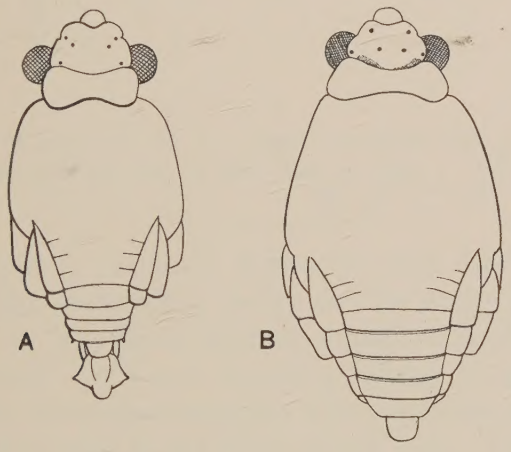
The present paper is based upon material collected by the John Murray Expedition and upon specimens contained in the collections of the British Museum (Natural History), The insects concerned are all referable to a species hitherto unknown, and it is here described as *Halobates sewelli* sp. nov., after Lt.-Col. Sewell, leader of the Expedition.

Occurrence.

(*a*) *John Murray Expedition.*—Station 61. Entrance to the Gulf of Oman, about half-way between the coasts of India and Arabia. Three females, one male and four nymphs. Taken in tow-net at night, November 8th–9th, 1933. Ten females, three males and nine nymphs taken in surface tow-net at night, November 8th, 1933.



Text-fig. 1.—*Halobates sewelli* sp. nov. A, male. × 12·5. B, female. × 12·5.

(*b*) *British Museum* (*Natural History*).—Red Sea, Genaba, near Farsan Is., February 26th, 1926. Twelve females, one male and six nymphs. Caught at 10 p.m. with light over stern. Sea temperature 80° F. Presented by W. Macfadyn (B.M., 1927–157).

Description of Male.

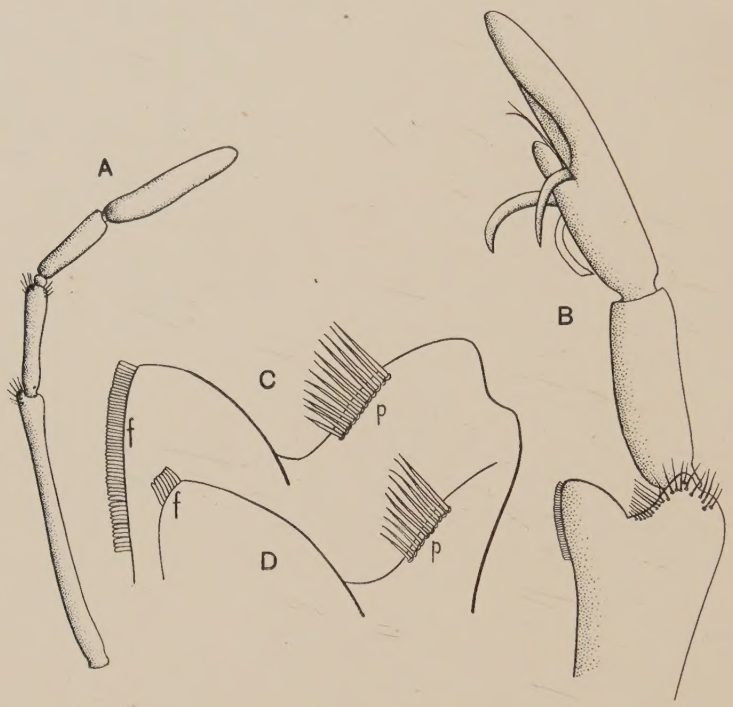
Coloration.—Uniformly blue-black above and below with ashy grey minute pubescence; fore femora similar. Eyes, antennæ, middle and hind legs, exposed parts of 8th abdominal segment, including styliform appendages, and ventral aspect of lateral lobes of 9th

abdominal segment, brown-black or black. Paired, wedge-shaped, rufous maculæ at base of head not, or only slightly, evident.

In alcohol, colour is steely blue, with the eyes chocolate brown and remaining parts brown-black.

Size.—Length 3·8 to 4 mm. Maximum breadth 1·75 mm. (Text-fig. 1A).

Antennæ.—Length 2·5 mm. The segments (Text-fig. 2) related in length as 11 : 4 : 3 : 5 (excluding the two small subsegments).



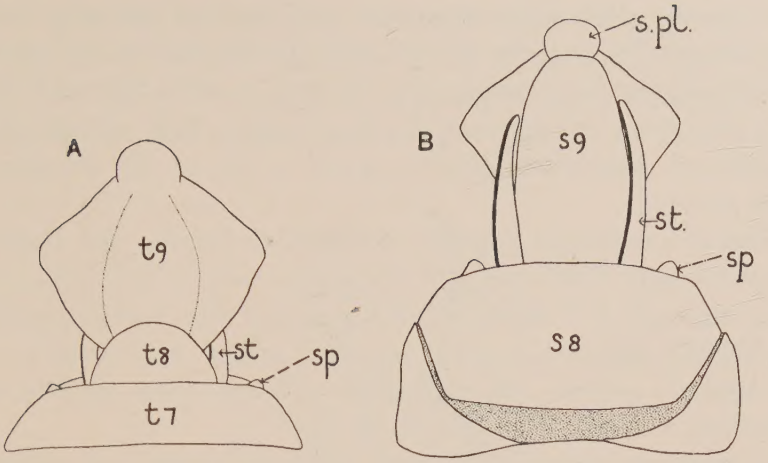
TEXT-FIG. 2.—*H. sewelli.* A, left antenna of male. × 50. B, apex of left tibia and tarsus of fore-leg of male. × 100. C, apex of left tibia of fore-leg of male. D, ditto of female, showing pecten *p* and "file" *f*. × 220.

Thorax.—Pronotum with sides somewhat rounded; anterior and posterior margins definitely concave. Mesonotum with shoulders well defined and rounded.

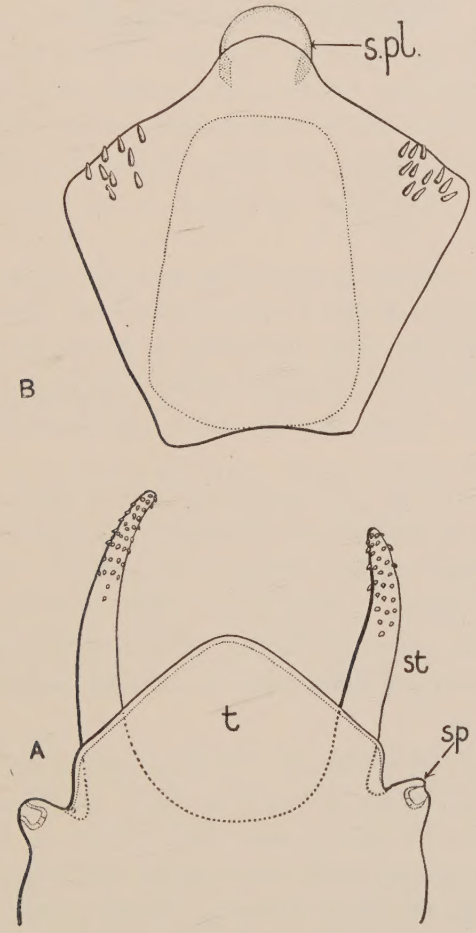
Fore leg.—Femur related in length to tibia as 25 : 19, or approximately as 4 : 3. Tarsal segments (Text-fig. 2) related in length as 8 : 13. Second tarsal segment with usual curved paired claws, together with a reflected translucent ribbon-like process whose apex is obliquely truncated; also arising from tarsal fossa is a very slender bifid seta. Tibia with a pecten of about 12 spines and a ventral file of about 50 closely set, blunt, peg-like spines (Text-figs. 2B and C).

Middle leg.—Femur 4·4 to 4·5 mm. long—·5 mm. shorter than tibia + tarsus. Femur related in length to tibia as 3 : 2. Tibia related in length to tarsus as 17 : 11, approximately as 3 : 2. Tarsal segments similarly related as 11 : 3. Two macrochætæ and an obscure ribbon-like appendage arising from fossa of 2nd tarsal segment, the latter ending in a sharp point with two subapical macrochætæ.

Hind leg.—Femur 3·75 to 4 mm. long; related in length to tibia + tarsus as 8 : 5. Tibia related to tarsus as 7 : 2. Tarsus armed with a long subapical macrochæta and, arising from the fossa, are two flattened claws and a macrochæta.



TEXT-FIG. 3.—*H. sewelli.* Apex of abdomen of male. A, dorsal aspect. B, ventral ditto. S_8, 8th abdominal sternum. S_9, 9th abdominal sternum. *sp.*, spiracular process. *s.pl.*, subanal plate. *st.*, styliform appendage (left in A, right in B). t_7 to t_9, 7th to 9th abdominal terga. × 60.



TEXT-FIG. 4.—*H. sewelli.* A, 8th abdominal segment of male (dorsal aspect). B, 9th tergum of male (dorsal aspect). *sp.*, spiracular process. *s. pl.*, subanal plate. *st.*, styliform appendage (left). *t.*, tergum. × 100.

Abdomen.—Dorsally, first three segments only defined laterally, subequal in size; 4th segment the longest, its anterior margin arched; 5th to 7th segments equal in size; visible parts of 8th segment consisting of a rounded median lobe and the apices of the paired spiracular processes; 9th segment about as broad as long, elevated down the middle, lateral lobes deflected somewhat, with a group of 10 or 11 denticles on each side (Text-figs. 1A, 3A and 4).

Ventrally, first five segments ring-like, subequal in length; 6th segment with sclerotized lateral lobes strongly developed and embracing sides of 7th segment; 7th segment nearly as long as segments 1–7 together; 8th segment with styliform processes incurved at apices, right slightly longer than left, and each armed with denticles over the distal one-third; 9th sternum convex, elongate-oval; sub-anal plate slightly transverse-ovoid (Text-figs. 3B and 4A).

Genitalia.—Pygophore (capsule of some authors) ovoid and globular. Aedeagus with a longitudinal fissure in the basal one-third; apex filiform. Parameres, left broader and shorter than right, curved distally; right narrower and more rod-like (Text-fig. 7B).

Description of Female.

Coloration.—Uniformly blue-black above and below, with ashy grey minute pubescence. Legs, antennæ and apex of abdomen brown-black or black; eyes rather paler. Intersegmental membranes between abdominal terga 3 to 5 in some specimens appear pale brown. Abdominal sterna 1 to 6 dark brown, with membranous areas pale brown. Wedge-shaped paired, rufous maculæ at base of head present, but often obscure.

Size.—Length 4·5 mm. Maximum breadth 2 to 2·5 mm. Broader and more ovoid than the male (Text-fig. 1B).

Antennæ.—Length 2·25 to 2·5 mm. First segment related in length to remaining segments together in proportion of 13 : 18 (in males as 11 : 12).

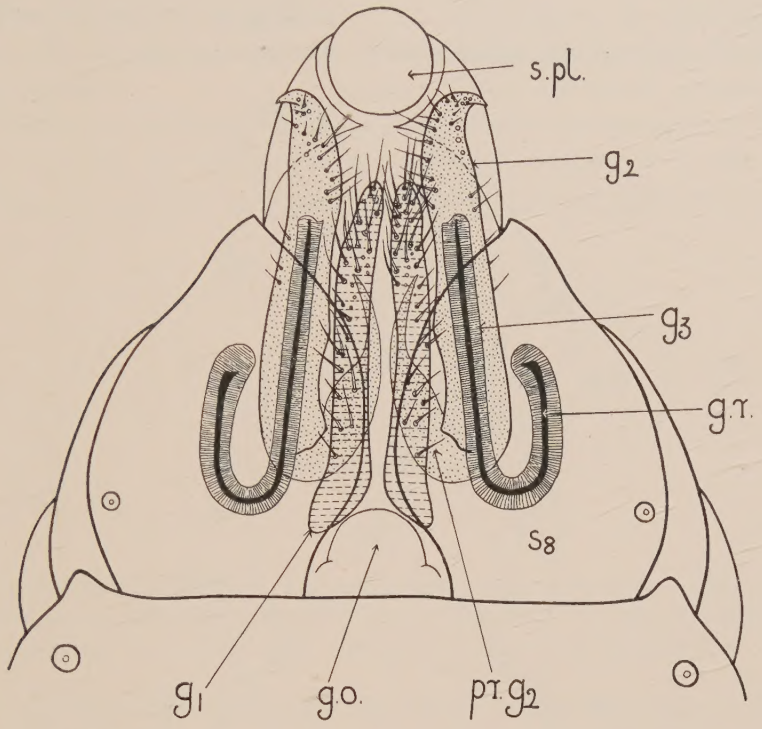
Fore leg.—Pecten at apex of tibia composed of about 10 spines; the "file" represented by about 7 closely set, blunt, peg-like spines (Text-fig. 2D).

Middle and hind legs.—These do not differ significantly from the corresponding parts in the male.

Abdomen.—Dorsally (Text-fig. 1B), segments 1 to 4 equal in length, a little shorter than any of segments 4 to 8, which are subequal in length. Segment 9 with rounded papilliform terminal lobe alone visible without dissection. Ventrally, first 6 segments narrow and annular, 6th segment produced and widened laterally; 7th segment longest and 8th segment in the form of paired valves; 9th segment with a backwardly-directed median lobe alone visible without dissection, a rounded subanal plate hinged to latter ventrally (Text-fig. 5).

Ovipositor.—Using the terminology employed by Carpenter (1906), the anterior valves are elongate and finger-like, beset throughout their length with macrochætæ. Inner posterior valves the longest, flattened, and each ending in a small, sharp, outwardly directed tooth; each valve is beset with small spines apically, and a row of long macrochætæ along distal one-third of inner margin; basally each valve gives off an inner, sharply-pointed, acuminate process. Along the outer margin of each valve is a sclerotized ridge, or "guide rail", which is prolonged basally into the body as a recurved ramus. Outer posterior valves articulating by means of grooves with the aforementioned ridges

(or guide rails) on inner valves ; each outer valve prolonged basally into a recurved ramus (Text-fig. 5). The above description applies to the ovipositor in the retracted condition ; when extended, the rami of the two pairs of posterior valves become straightened, thus allowing of the extension of the parts involved.



TEXT-FIG. 5.—*H. sewelli*. Ovipositor, ventral aspect. g_1, anterior valve. g_2, inner posterior valve. g_3, cuter posterior valve. *g.o.*, genital operculum. *g.r.*, "guide rail" of inner posterior valve. *pr.* g_2, inner process of valve g_2. S_8, right plate of 8th sternum. *s.pl.*, subanal plate. × 84. (*Note.*—Anterior valves are shaded with cross-lines and inner posterior valves have dot shading.)

COMPARISONS WITH ALLIED SPECIES.

H. sewelli appears to be more closely allied, structurally, to *H. hayanus* White than to any other species of the genus. This fact has led me to investigate the genitalia and the 8th and 9th abdominal segments of Buchanan White's type of *H. hayanus* in the collection of the British Museum (Natural History). The chief differences are shown in Figs. 4 and 6, and are also expressed in tabular form below :

H. sewelli sp. nov.	*H. hayanus* White.
The 8th abdominal tergum narrowed considerably towards apex of median posterior lobe.	Median posterior lobe of 8th tergum distinctly broader apically.
Right styliform process somewhat longer than left and both processes incurved distally.	Styliform processes of equal length and slightly curved outwards distally.
Denticles over distal one-third of each styliform process.	Denticles over distal one-fourth of each styliform process.

H. sewelli sp. nov.—*cont.*

Lateral angles of 9th tergum produced just beyond proximal half of that sclerite. Lateral denticles 10 or 11 on either side.

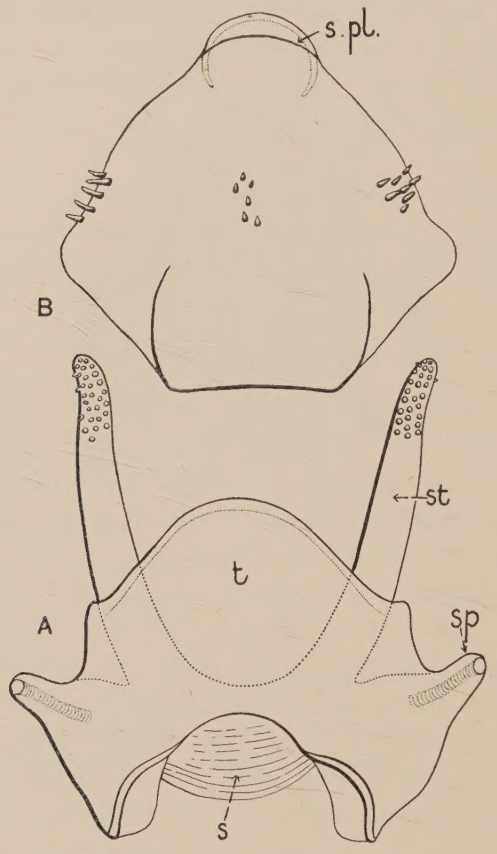
Parameres small, slightly narrowed towards apices (Text-fig. 7B).

H. hayanus White.—*cont.*

Lateral angles of 9th tergum produced within the proximal half of that sclerite. Lateral denticles less numerous.

Parameres very distinctly larger with distal extremities broader (Text-fig. 7A).

The ædeagus shows no significant differences in the two species.



TEXT-FIG. 6.—*Halobates hayanus* White (type). A, 8th abdominal segment of male (dorsal aspect). B, 9th abdominal tergum of male (dorsal aspect). *s.*, sternum. Other lettering as in Text-fig. 4. × 100.

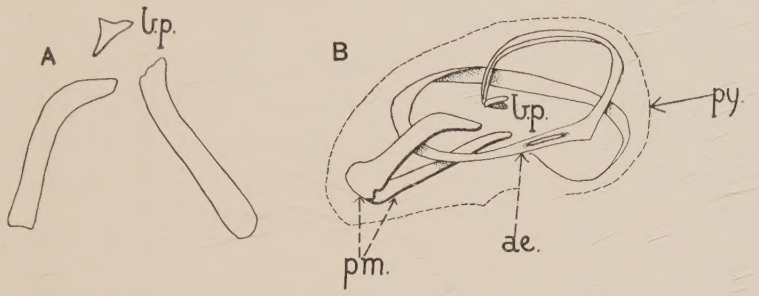
In coloration both sexes of the two species can be separated at a glance. The conspicuous yellowish ochreous bases to the antennæ, and the extensive suffusion of the same colour ventrally in *H. hayanus*, readily separates that species from the unicolorous, blue-black, *H. sewelli*. In the male of *H. hayanus*, the 9th tergal shield is more or less yellow ochreous, whereas in *sewelli* it is blue-black or black.

According to Buchanan White, *H. hayanus* is closely related to *H. proavus* White. Esaki (1930), who has examined the male type specimen of *H. proavus* in the collection of the British Museum (Natural History), states that this species is identical with *H. rotundatus* Esaki from New Guinea (*vide* Esaki, 1926). He remarks that Buchanan White's figures and description are very inaccurate. The very short first segment of the fore tarsi, of both sexes, and the pronounced asymmetry of the styliform processes of the 8th abdominal segment, as figured by Esaki, serve to separate *H. proavus* from both *H. hayanus* and *H. sewelli*.

H. sewelli closely resembles *H. sericeus* Esch. in coloration, but, from Buchanan White's description (1883), there are evident structural differences in the males as shown in tabular form below :

H. sewelli sp. nov.	*H. sericeus* Esch.
Middle tibia definitely longer than tarsus ; tarsal segments related in length as 11 : 3. Apical half of disc of 8th segment devoid of teeth.	Middle tibia a little shorter than tarsus ; tarsal segments related in length as 7 : 1. Apical half of disc of 8th segment with short, outwardly pointing teeth.

H. flaviventris Esch. (*herdmani* Carp.) may be easily separated from *H. sewelli* by the tarsal segments of the fore leg being subequal in length, whereas in *sewelli* they are related as 8 : 13. The females may also be separated upon structural differences in the ovipositor, as mentioned on p. 78.



TEXT-FIG. 7.—A, parameres of *Halobates hayanus* White (type) with basal plate, *b.p.* × 104. (Distal extremities of parameres are nearest the basal plate.) B, male genitalia of *H. sewelli* sp. nov. *æ.*, ædeagus. *b.p.*, basal plate. *p.m.*, parameres. *py.*, pygophore. × 104.

The well-known fact that the genus *Halobates* occurs throughout the warmer seas suggests that temperature is a limiting factor in its distribution. Since these insects are wingless, surface-living forms, their extremely wide geographical range is also most probably strongly influenced by ocean currents—a factor which has not so far attracted much attention. From data available, for example, in the recent text-book by Schott (1935), it will be seen that the occurrence of *H. sewelli*, in both the Red Sea and near the Gulf of Oman, is on the direct courses of the prevailing marine currents. During February and March the flow is from the Gulf of Oman and up the Red Sea, while in August and September the currents are in the reverse direction. Further afield the prevailing ocean currents suggest that this species will probably be found in most parts of the Arabian Sea and possibly over a wider area. As regards the allied species, *H. hayanus*, the general course of the currents would account for its distribution off Singapore and New Guinea, while the North Equatorial current is possibly responsible for its occurrence so far away as the Red Sea.

CONCLUDING REMARKS.

The paper by Buchanan White (1883) in the Reports of the " Challenger " Expedition, still forms the basis for the study of the genus *Halobates*. At the time it was written the characters adopted for special diagnoses were sufficient for that purpose but, with the subsequent descriptions of a number of additional species by T. Esaki and others, it has become more difficult to differentiate them solely upon the characters adopted by Buchanan White. Some of the more important features are afforded by the 8th and 9th abdominal

segments together with the genitalia in the male. Most writers have investigated these features superficially while the genitalia have been totally neglected. By following Buchanan White's description only, *H. sewelli* sp. nov. would be regarded as a dark, unicolorous form of *H. hayanus* White. A study of the prepared mounts of the parts in question, however, revealed the obvious distinctness of these two forms.

Without the associated males, the females of many species of *Halobates* are sometimes only to be identified with difficulty. This obvious disadvantage may possibly be overcome by a thorough examination of the minute structure of the ovipositor in each case. Buchanan White neglected this organ, and merely stated that it is composed of two pairs of valves. Nasonov (1897) figures the ovipositor with a similar composition. It remained for Carpenter (1906) to investigate the ovipositor more fully, using the species *H. flaviventris* Esch. (*herdmani* Carp.) for the purpose. He gave reasons for concluding that three pairs of valves are present as in a typical, complete, insect ovipositor. A comparison of the ovipositor in *H. sewelli*, with Carpenter's description of the same organ in *H. flaviventris*, reveals evident differences in the form of the genital operculum and the inner posterior valves. His figures are not, however, sufficiently detailed to make a close comparison. No other writer has studied the character of the ovipositor in this genus. It is necessary, therefore, to emphasize that the matter of separating the females of the species of *Halobates* may ultimately be placed on a surer basis if the structure of the ovipositor be closely examined.

As regards the true morphological interpretation of certain parts of the ovipositor, further work on ample material is needed. In the foregoing account of that organ in *H. sewelli*, it will be noted that the inner appendages (or processes), described by Carpenter as belonging to the anterior valves, are here regarded as integral parts of the inner posterior valves since, upon dissection, they are found to be attached to the latter structures.

In preparing this paper, after an examination of Buchanan White's and other specimens in the British Museum (Natural History), I have become impressed by the need for a thorough revision of the genus *Halobates*. In its absence, confusion is likely to result from the descriptions of further new species if they are based upon the limited range of rather superficial characters, as is at present customary.

I wish to express my indebtedness to Mr. W. E. China for valued assistance, and especially for his dissection of the male genitalia, and associated parts, of Buchanan White's type of *Halobates hayanus* in the British Museum (Natural History). Esaki's statement (1926), that the types of this species are in the Zoological Museum in Berlin, appears to be an error, since, inquiry made by Mr. W. E. China led to the reply that these types are not located there.

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